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AN EVALUATION OF THE CURRENT CALIFORNIA METHOD TO DETERMINE AC OVERLAY THICKNESS

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This study was conducted in cooperation with the U.S. Department of Transportation, Federal Highway Administration.

16. ABSTRACT

An evaluation was made of the present overlay design method (Test Method No. Calif. 356) by investigating projects that had been in place for ten years or failed prior to the planned ten year design life. The investigation consisted of a search of office files and field condition surveys.

The findings of this study support the deflection analysis method of overlay design that was implemented by the Transportation Laboratory in 1969.

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DEPARTMENT OF TRANSPORTATION
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OFFICE OF TRANSPORTATION LABORATORY

June 1980

FHWA F77TL01
TL No. 633169

AN EVALUATION OF THE CURRENT CALIFORNIA METHOD TO DETERMINE AC OVERLAY THICKNESS

Study Made by .... Soil Mechanics and Pavement Branch

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Appreciation is also expressed to the District Maintenance and Materials personnel for their efforts in obtaining information relative to the roadway maintenance that had been performed.

CONVERSION FACTORS

English to Metric System (SI) of Measurement

Quanity	English unit	Multiply by	To get metric equivalent
Length	inches (in)or(")	25.40 .02540	millimetres (mm) metres (m)
	feet (ft)or(')	.3048	metres (m)
	miles (mi)	1.609	kilometres (km)
Area	square inches (in^2) square feet (ft^2) acres	6.432×10^{-4} .09290 .4047	square metres (m^2) square metres (m^2) hectares (ha)
Volume	gallons (gal) cubic feet (ft^3) cubic yards (yd^3)	3.785 .02832 .7646	litres (l) cubic metres (m^3) cubic metres (m^3)
Volume/Time (Flow)	cubic feet per second (ft^3/s)	28.317	litres per second (l/s)
	gallons per minute (gal/min)	.06309	litres per second (l/s)
Mass	pounds (lb)	.4536	kilograms (kg)
Velocity	miles per hour(mph) feet per second(fps)	.4470 .3048	metres per second (m/s) metres per second (m/s)
Acceleration	feet per second squared (ft/s^2)	.3048	metres per second squared (m/s^2)
	acceleration due to force of gravity(G)	9.807	metres per second squared (m/s^2)
Weight Density	pounds per cubic (lb/ft^3)	16.02	kilograms per cubic metre (kg/m^2)
Force	pounds (lbs) kips (1000 lbs)	4.448 4448	newtons(N) newtons (N)
Thermal Energy	British thermal unit (BTU)	1055	joules (J)
Mechanical Energy	foot-pounds(ft-lb) foot-kips (ft-k)	1.356 1356	joules (J) joules (J)
Bending Moment or Torque	inch-pounds(ft-lbs) foot-pounds(ft-lbs)	.1130 1.356	newton-metres (Nm) newton-metres (Nm)
Pressure	pounds per square inch (psi) pounds per square foot (psf)	6895 47.88	pascals (Pa) pascals (Pa)
Stress Intensity	kips per square inch square root inch (ksi $\sqrt{in}$)	1.0988	mega pascals $\sqrt{metre}$ (MPa $\sqrt{m}$)
	pounds per square inch square root inch (psi $\sqrt{in}$)	1.0988	kilo pascals $\sqrt{metre}$ (KPa $\sqrt{m}$)
Plane Angle	degrees (°)	0.0175	radians (rad)
Temperature	degrees fahrenheit (F)	$\frac{tF - 32}{1.8} = tC$	degrees celsius (°C)

TABLE OF CONTENTS

TABLE 1

Thickness of Pavement	Type of Pavement	Max. Permissible Deflection
8 in.	Portland Cement Concrete	0.012 in.
6 in.	Cement Treated Base (Surfaced with Bituminous Pavement)	0.012 in.
6 in.	Asphalt Concrete	0.012 in.
4 in.	Asphalt Concrete	0.017 in.
3 in.	Asphalt Concrete	0.020 in.
2 in.	Asphalt Concrete	0.025 in.
1 in.	Road Mixed Asphalt Surfacing	0.036 in.
1/2 in.	Surface Treatment	0.050 in.

The tolerable deflections (maximum permissible deflection) presented in Table 1 eventually provided the basis for the application of pavement deflection data to overlay design. Since these tolerable deflection values were accumulated over roads with traffic indices of approximately 9, a method to adjust tolerable deflection levels according to variation in traffic volume was established from the results of laboratory fatigue tests on asphalt concrete samples(2).

California began using deflection data in conjunction with the tolerable deflection concept for the evaluation of existing flexible pavements and as the basis for recommending suitable overlays for reconstruction in 1960. Between 1960 and 1966, data were accumulated on the deflection attenuation characteristics of AC, CTB and AB which, with the tolerable deflection criteria already established, provided the basis of the California overlay design procedure. By 1966, some 80 projects including state highways, county roads, and city streets had been

INTRODUCTION

Pavement deflection measurements are now being utilized by many public agencies to design asphalt concrete overlay thickness by various analysis procedures. A review of the literature, however, did not reveal any published information on how well these various procedures provide the service life extension used as the "design life". The primary purpose of this study was a comprehensive evaluation of the effectiveness of the California procedure.

California has utilized deflection measurements for the evaluation of flexible pavements since 1938. In 1951, a series of comprehensive deflection research studies was initiated by the Transportation Laboratory in an effort to establish a tie between pavement deflection levels and pavement performance. The results and conclusions of the first formal study were published in 1955(1). An evaluation of the data with respect to pavement deflections versus pavement conditions permitted the establishment of the concept of "tolerable deflection" criteria for a variety of structural sections. The term "tolerable deflection" as first used and shown in Table 1 is that level beyond which repeated deflections of that magnitude will produce fatigue cracking in the surface.

GENERAL CONCLUSIONS

The Deflection Analysis Design Method (Test Method No. Calif. 356) as presently used to determine the overlay thickness for structural overlays for state highways and city and county roadways gives good results. The planned design life of the structural overlays designed by this method and included in this study was 10 years. Their mean (actual) service life is about 11.6 years.

subjected to deflection investigations. The results of the use of the deflection method for overlay design were reported to the Transportation Research Board in 1966 along with a discussion of the overlay design procedure(2). This procedure was formally adopted in 1969 as a California test method(3).

In 1970, a state of the art paper on California's overlay design method was presented at the Western Summer Meeting of the Highway Research Board(4). In 1974, a report was published introducing an AC overlay design guide which simplified the procedure for determining AC overlay thicknesses. Revised deflection attenuation curves and tolerable deflection levels of asphalt concrete pavements, based on the performance of highway projects (new construction) under study since 1964, were also included in this report(5).

The present study constitutes an evaluation of our overlay design method after use for more than 10 years by reviewing the actual service life of pavement overlays compared to their predicted design life. In determining actual overlay service life, it is recognized that a pavement does not fail via a single discrete event as do other structures. Thus most of the indicators of pavement condition (extent and type of cracking, patching, rutting, etc.) are not fully quantifiable. Judgment as to length of service is entirely subjective and thus subject to some degree of variation.

SPECIFIC FINDINGS

1. Structural overlays of asphalt concrete pavements (40 projects) designed and constructed in accordance with the Deflection Analysis Method (Test Method No. Calif. 356) have a mean service life of 138.6 months (11.6 years) with a standard deviation of 28.1 months (2.3 years).

2. Use of the Engineering Judgment Method (36 projects) resulted in a mean service life of 94 months (7.8 years) with a standard deviation of 22.9 months (1.9 years).

3. Use of the Gravel Equivalent Method (16 projects) resulted in a mean service life of 100 months (8.3 years) with a standard deviation of 24.5 months (2.0 years).

4. The comparison of the Deflection Analysis Design Method (Test Method No. Calif. 356) to the Engineering Judgment Method and Gravel Equivalent Method shows the deflection method to give the best results from the standpoint of selecting the proper thickness to last the design period of 10 years.

RECOMMENDATIONS

The California overlay design method utilizing deflection measurements and tolerable deflection criteria established over the past several years, should be used exclusively to design structural overlays for flexible pavements in California.

GENERAL DISCUSSION

Since the inception of this project, a study was initiated by the Division of Maintenance and conducted by the Transportation Laboratory that included an evaluation of the service lives of pavements rehabilitated using several different strategies. Among the strategies considered was the asphalt concrete overlay. Pertinent data from this study of the structural overlays and the report "Establish Criteria for Rehabilitation of California Pavements"(6) will be included with these results.

Determination of the "actual life" of an asphalt concrete pavement or overlay is not an easy task. Pavements do not "wear out" or fail simultaneously over the entire project length nor do they fail suddenly as may a bridge or building. Problems usually begin with isolated cracking. Traffic loads and weather conditions that tend to accelerate the cracking vary considerably throughout the state. Also, the deterioration rate or the time from first maintenance work until the roadway is in need of an overlay in the past has been largely based on subjective criteria. A pavement deemed in need of an overlay by one observer in one part of the state might not qualify in the eyes of another observer from a different area.

Substantial land use changes have occurred over the past 10 to 15 years, and California's highway, road and street system has changed accordingly. This has resulted in alignment changes, widening, and improved or reconstructed structural sections on candidate projects for this study. The overlaid projects "lives" were thus disrupted for reasons other than premature failure. It was also found

IMPLEMENTATION

The findings of this study support the validity of the deflection method of overlay design which was implemented with the adoption of Test Method No. Calif. 356 in 1969. In years past, it was used as an alternate method for overlay design when this service was requested by a Transportation District, County, City, Airport Authority, or other public agency. As mentioned in the text of this report, the California Department of Transportation has recently implemented a Pavement Management System (PMS). On the basis of their findings regarding the deflection method (and further confirmed by this study), all eleven Transportation Districts now utilize the deflection method of design for structural overlays of existing flexible pavements. The deflection method has been selected as the standard procedure when a structural analysis has been determined to be the appropriate strategy based upon the biennial pavement condition surveys and the PMS printouts.

extensive longitudinal and transverse or shrinkage cracks forming large block cracks across the entire lane width. Thus most overlays for CTB structural sections are for control of reflection cracking rather than structural adequacy since the deflection level will be relatively low. If the base has failed, the same failure mode as aggregate base structural sections with fatigue cracking in the wheel path will appear.

For this study, the months of service for each project were determined by either the PMS printout using the 30 percent criteria or by the following method. If the PMS printout did not provide information on the pavement section in question, the project was visited and a condition survey was made to determine the months of service. From the observed present cracked condition of the roadway, it was not difficult to estimate (as will be pointed out later in this text) at what time in the past or future the 30 percent criteria was or would be met.

Project Selection and Evaluation

Since the initial use of the deflection method procedure in California, there have been more than 500 projects for which overlays were designed on the basis of deflection measurements. While the majority of these, during the early 1960s, were done for cities and counties, a file search back to 1962 resulted in approximately 100 state projects selected for follow-up study. The monthly issues of the "Statement of Going Contracts" published by the California Department of Transportation were reviewed to determine the work performed and the contract numbers. The microfilm index of "as built plans" was that maintenance work to improve riding quality and skid resistance, performed while pavements were still structurally sound, prematurely eliminated many candidate overlay projects from further consideration.

Failure Criteria

During the initial phases of this study, it became apparent that the overall objective was simply the performance of the overlay to provide a nearly maintenance free roadway for the 10 year design period. Therefore, the most accurate and direct approach in evaluating the overlay performance would be to review the maintenance effort, if any, employed in keeping the pavement surface in service for the 10 year design period. Thought was given to, but no need was determined, for any laboratory testing or follow-up deflection measurements in reviewing past performance.

The service life, as previously discussed, can have different meanings when determined by subjective methods. This problem was studied in some detail during development of the Pavement Management System. The definition of service life which evolved and which is now included in the Pavement Management System is as follows: "Service Life" is the period of time until the extent of load associated alligator cracking and/or patching reaches 30 percent of the roadway wheel path areas. The Pavement Management System definition was adopted for this study. As an illustration of the convention used in reporting "percent cracked", a lane with continuous alligator cracking and/or patching in one wheel path and no cracking in the other wheel path would be classified as 50 percent cracked. For pavements over cement treated bases, the same criteria are used. The failure mode for CTB involves

In the present study, field condition surveys were made to each district to review the projects where data could not be obtained from office files alone. This resulted in an additional 14 projects for a total of 22 state projects which were eventually evaluated in this study (see Tables 2 and 3).

From the study "Establish Criteria for Rehabilitation of California Pavements"(6), although limited to thin overlays, it was found that the deterioration rate of hairline alligator cracking to 1/8 inch alligator cracking occurs, on the average, in twelve months. Within another eight months, the 1/8 inch wide alligator cracking progresses into 1/4 inch wide alligator cracks. Within another four months, the alligator cracking continues and is coded only as "greater than 1/4 inch cracking". Thus, from 1/8 inch wide cracks to cracks greater than 1/4 inch in width occurs in about one year. Again, while this is for thin blankets, it does give some indication as to the time for the propagation of cracks--once cracking starts.

From the study "Statewide Flexible Pavement Performance and Deflection Study"(7), the time for the percentage of cracking to approach 30 percent was noted to be 2 to 4 years after the initial (reported as initial cracking when 2-5% cracked) alligator cracking. The average from the study was 2.8 years.

Using the experience gained from these two projects, the extrapolated point in time considered as the end of the overlay service life could be rationally and conservatively estimated. An example of extended time would be searched for each contract and the required information extracted.

Following the final selection of the projects, an effort was made to obtain information for specific locations on maintenance and repair activity. However, this information was unavailable for several projects. Thus what was originally believed to be the best source of information produced very little. The second source of information, the biennial pavement evaluation surveys extending back to 1969 and some pavement deflection research data dating back to 1964, provided a portion of the overlay performance criteria.

This data was initially studied by the researchers for the Pavement Management System as a part of their work to develop pavement performance criteria and pavement maintenance and rehabilitation strategies. The scope of their work was much broader than that of this study. Consequently, the PMS researchers did not have the resources needed to field review individual overlay projects. This constraint quickly eliminated from their consideration any project that could not be evaluated solely from the biennial survey printouts. Additional projects were eliminated simply because of differences in post mile limits between the project in question and the rated sections. Thus, in the PMS developmental effort, out of about 100 candidate projects, only 8 remained. The 8 projects performed well with an average service life of 129 months (10.8 years) and an estimated standard deviation of 13.6 months. Although these researchers found only a small number of projects for evaluation using the PMS printouts, their results compared favorably with the planned overlay design life of 10 years.

traffic volumes. It was reasoned that cities and counties might be more apt to reduce the recommended overlay thickness due to a lack of funds. From such projects, it might then be possible to determine the effects of using the overlay method to design projects for service lives of less than 10 years. However, this was not the case for the projects that were available for evaluation. If the overlay had been placed at all, the recommended thickness was used. If not, the project was delayed and overlaid at a later date. The later date would invalidate the earlier deflection study and crack survey making it impossible to use for our research study. The evaluation of the city and county projects produced an additional 18 roadways with T.I.'s from 4.0 to 9.5 (see Tables 2 and 3). These projects provided a mean service life of 146.0 months (12.2 years) with a standard deviation of 23.7 months (2.0 years).

Although it was more difficult to obtain projects for this evaluation than anticipated, the 40 combined state, city and county roadways provided an adequate number to draw conclusions with a reasonable degree of confidence. Notes regarding the determination of service life for each project included in the study are contained in Table 3.

The service life of an overlay designed by the present deflection method is about 11 years. The service lives of two-thirds of the state projects studied are between 8.5 and 13.5 years. The corresponding range for city and county projects is between 10 and 14 years. Overall, the deflection designed projects are within a reasonable tolerance of the desired 10 year design period.

the project 02-Sis-97 (No. 1) where from the field review the present condition of the pavement showed 20 to 25 percent alligator cracking. By next year this project will have reached its "service life" by our definition of 30 percent. The time of service for this project then of 1973-1981 or 96 months (9 years) is a reasonable extrapolation. Another example would be project 06-Fre-41 (No. 16). Here the condition survey showed the pavement to be approximately 60 to 70 percent alligator cracked. As the rate of cracking accelerates quite rapidly beyond the 30 percent level, a reduction in service life of 2 years was estimated to place the percent cracking at or below the 30 percent level. This should give a conservative estimate of service life of the project. Projects such as Numbers 2 and 5, with little or no cracking, indicated during the field condition survey, have been assigned an additional one or two years of service life. Two years was used except in a few instances where other factors noted in the field suggested service life extension should be limited to one year. Again, these are very conservative estimates but further extension of time would not be prudent.

Analysis of the 22 state projects with the T.I.'s varying from 7.0 to 10.5 yielded an average service life of 132.5 months (11.0 years) with a standard deviation of 30.4 months (2.5 years) (see Tables 2 and 3).

As it became apparent that state projects alone were small in number for the purpose of the study, the same process of evaluation was used for deflection designed city and county roadway overlay projects. Their inclusion also permitted evaluation of projects with lower

TABLE 2

Summary of Project Data With Overlays
Designed by Calif. Deflection Procedure

Project	T.I.	Overlay Thickness	Estimated Service Life(Mos.)
1	10.0	0.20'	96
2	7.0	0.10'	108
3	9.5	0.40'	132
4	9.0	0.50'	144
5	10.5	0.25'	192
6	10.5	0.25'	84
7	10.5	0.30'	96
8	10.5	0.20'	120
9	8.6	0.25'	180
10	10.0	0.17'	168
11	10.5	0.25'-0.29'	120
12	10.5	0.33'+Cushion Coarse	130
13	9.0	0.17'	180
14	8.0	0.33'	156
15	10.0	0.30'+Cushion Coarse	132
16	8.5	0.08'	132
17	8.5	0.20' & 0.15'	132
18	9.5	0.33'	156
19	10.5	0.17'	144
20	9.0	0.40' & 0.25'	120
21	7.0	0.25'	96
22	8.0	0.10' & 0.20'	96
23	6.0	0.20'	144
24	6.0	0.20'	132
25	6.0	0.25'	120
26	6.0	0.20'	120
27	7.5	0.15'	120
28	8.5	0.15'	120
29	9.0	0.17'	132
30	4.5	0.20'	156
31	-	0.25'	180
32	4.0	0.17'	168
33	4.0	0.17'	168
34	4.0	0.17'	168
35	4.0	0.17'	168
36	6.0	0.17'	144
37	7.0	0.08'	108
38	8.0	0.08'	132
39	6.0	Dbl. Chip Seal	168
40	7.0	0.17'	180

$\bar{X}$ = 138.6 Mos.(11.6 yrs.)

S = 28.1 Mos.(2.3 yrs.)

A comparison of this data to that obtained in the study for the PMS project(6) for the engineering judgment method and the gravel equivalent method shows the deflection method to give the best results. The engineering judgment method essentially uses subjective judgment and/or the past experience of the engineer to determine the overlay thickness. The average service life for the 36 overlays designed by this method was found to be 94 months (7.8 years) with a standard deviation of 22.9 months (1.9 years). The primary problem with this approach is that the intuitive judgment of the engineer determining the thickness is influenced by the outward appearance of the roadway which does not always reflect the actual residual strength of the existing structural section.

The gravel equivalent method is based upon future traffic (Traffic Index) and gravel equivalent (G.E.) values of the in-place roadway materials. The primary problem associated with this approach is that of assigning a realistic gravel factor to the existing distressed AC surface. Also, the system requires the assumption of a saturated subgrade condition which may not be representative. The average service life for the 16 projects designed by this method was found to be 100 months (8.3 years) with a standard deviation of 24.5 months (2.0 years). Because the G.E. method would tend to be conservative, the results from this study are somewhat surprising. This may perhaps be attributed to the small number of projects found to study.

Attempts to relate the service life data to the various geographic/topographic areas (and associated climatic differences) of the state did not produce any significant findings possibly due to insufficient data.

TABLE 3

	Project	Traffic Index	Overlay Thickness	Date Placed	Service Life
1.	02-Sis-97 34.6/40.6	10.0	0.20'	9-73	96 months

Comments:

The project was reviewed during February, 1980. Wheelpath cracking was approaching 25%, with very little patching. Project started to ravel in 1974 at which time a fog seal was applied as per the maintenance superintendant. It appears that portions of this project should have an additional overlay by next year (1981) and, without rehabilitation, the entire project should not last past 1982. It would seem reasonable to assign a service life for this project of 8 years or until summer of 1981 (96 months).

	Project	Traffic Index	Overlay Thickness	Date Placed	Service Life
2.	02-Sha-44 62.7/66±	7.0	0.10'	11-73	108 months

Comments:

This project was placed in 1973. The only section that could be evaluated was the section 62.7/66±. As per the maintenance superintendant, the only treatment to date was a Reclamite seal in 1975, due to a raveling problem. The condition survey made in February, 1980 showed the section to be in excellent condition with very little longitudinal cracking and almost no alligator cracking. The projected service life is 1982 (9 years).

	Project	Traffic Index	Overlay Thickness	Date Placed	Service Life
3.	03-Sut-99 8.2/10.9	9.5	0.40'	8-67	132 months

Comments:

This project was one used in the PMS study. Their review showed approximately 20% wheelpath cracking during the 1978 bienniel survey. The projected service life for the project is 11 years.

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	Project	Traffic Index	Overlay Thickness	Date Placed	Service Life
7.	04-SCL-82 (Sylan to Mathilda)	10.5	0.30'	1974	96 months

Comments:

An Overlay was placed in 1974, presumably during the summer. As per the 1977-78 PMS survey, no maintenance work has been performed on this section. A condition survey was made during February, 1980. The surface appeared to be dried out with no cracking in evidence. The adjacent lane showed CTB reflection cracking, but cracks did not extend into the project area. The project could easily be extended to 1982 for service life of 8 years.

	Project	Traffic Index	Overlay Thickness	Date Placed	Service Life
8.	05-Mon-101 43.5/52.4	10.5	0.20'	6-69	120 months

Comments:

District maintenance reports a Reckmite seal in 1973. The condition survey made during December, 1979 showed the project nearing the end of its service life. Outer wheel track had nearly continuous alligator cracking (25%±). Service life is estimated at 10 years±.

	Project	Traffic Index	Overlay Thickness	Date Placed	Service Life
9.	05-Mon-183 0.6/1.7	8.6	0.25'	6-63	180 months

Comments:

This project was one used in the PMS study. As per the PMS survey, the project was overlaid in the summer of 1978 with a 1" blanket. Service life ends in 1978 (15 years).

	Project	Traffic Index	Overlay Thickness	Date Placed	Service Life
4.	04-SCL-156 0.0/0.7	9.0	0.50'	7-68	144 months

Comments:

This project was one used in PMS study. Their 1978 survey showed no alligator cracking. The condition survey made during December, 1979 showed isolated transverse and longitudinal cracks. Alligator cracking in the wheelpaths was approximately 5%. The overall appearance was good. This project should last at least 1 to 2 more years. The projected service life is 12 years.

	Project	Traffic Index	Overlay Thickness	Date Placed	Service Life
5.	04-SM-35 28.7/29.8	10.5	0.25'	1-65	192 months

Comments:

This project was one used in PMS study. The condition survey made during February, 1979 showed the project to be in excellent condition. There were no signs of cracking. There was a slight amount of ravelling across the entire roadway surface (both lanes). Project service life can be projected to 1981 (16 years).

	Project	Traffic Index	Overlay Thickness	Date Placed	Service Life
6.	04-SCL-152 26.2/31.8	10.5	0.25'	12-63	84 months

Comments:

No condition survey could be made on this project. Beginning in 1970, thin blankets were placed over this project. Blankets were also placed in 1972 and 1973. This information was received from PMS surveys. Project service life was assigned the year of the first thin blanket (1970) or 7 years.

	Project	Traffic Index	Overlay Thickness	Date Placed	Service Life
13.	05-SBt-156 0.0/8.6	9.0	0.17'	11-61	180 months

Comments:

A condition survey made during December, 1979 showed the pavement to have received a thin overlay in recent years. Checking with the district determined the placement of a thin blanket in 1976. Project service life was assigned the year the first thin blanket was placed or 1976 (15 years).

	Project	Traffic Index	Overlay Thickness	Date Placed	Service Life
14.	05-SB5-156 12±/15±	8.0	0.33'	1-63	156 months

Comments:

Same as above project (13 years).

	Project	Traffic Index	Overlay Thickness	Date Placed	Service Life
15.	06-Tul-65 17.5/18.7	10.0	0.30' + (Base Cushion)	1969	132 months

Comments:

This project was reviewed by PMS surveys. The project was chip sealed in 1975. Present condition (1978 PMS) shows little to no load associated cracking with a small amount (1+%) of patching. The project service life could conservatively be extended 2 years to 1980 (11 years).

	Project	Traffic Index	Overlay Thickness	Date Placed	Service Life
10.	05-Mon-101 21/32	10.0	0.17'	7-62	168 months

Comments:

This project was used in the PMS study. The project was overlaid in 1976 prior to relinquishment to the county in 1976. Service life is estimated to be 14 years.

	Project	Traffic Index	Overlay Thickness	Date Placed	Service Life
11.	05-SLO-101 46.3/56.0	10.5	0.25'-0.29' (varies with section)	10-64	120 months

Comments:

This project was used in the PMS study. From the PMS report data, this project was overlaid in 1975 with an open graded surface at which time the project had approached 30% wheelpath cracking. Service life as determined from the PMS study was 10 years±.

	Project	Traffic Index	Overlay Thickness	Date Placed	Service Life
12.	05-SLO-101 29.1/37.9	10.5	0.33'+ cushion coarse	6-62	130 months

Comments:

A condition survey indicated a new surface in recent years. Checking with district showed reconstruction on the project at different times. The average service life of 130 months for the project was determined from district records.

	Project	Traffic Index	Overlay Thickness	Date Placed	Service Life
19.	07-Ora-90 2.8/10.0	10.5	0.17'	1967	144 months

Comments:

The condition survey conducted during March, 1980 showed nearly continuous alligator cracking in outside wheel track of the No. 2 lane. The portions that could be rated were noted to have approximately 50 percent alligator cracking with 30 percent patching. Service life should be reduced 1 year (12 yrs.).

	Project	Traffic Index	Overlay Thickness	Date Placed	Service Life
20.	08-SBd-18 76.6/77.3	9.0	0.40' & 0.25"	4/71	120 months

Comments:

The condition survey conducted during March, 1980 showed the pavement to have 15 to 20 percent wheel path cracking. Some locations had chip seal patches. The overall condition of the roadway was fairly good. The service life is extimated at 10 years.

	Project	Traffic Index	Overlay Thickness	Date Placed	Service Life
21.	09-Mno-395 79.084.0	7.0	0.25'	8/70	96 months

Comments:

This pavement was rated as per PMS survey. Alligator cracking was rated as 7 percent and the majority of the project was cinder chip sealed which could be due to snow and chain wear. However, to be conservative, a service life of 8 years (1978 survey) is estimated.

	Project	Traffic Index	Overlay Thickness	Date Placed	Service Life
16.	06-FRE-41 25.4/26.8	8.5	0.08'	1966	132 months

Comments:

A condition survey of this project was conducted during December, 1979. Almost continuous longitudinal and transverse cracking were noted with 60-70 percent alligator cracking. Sealed joints appeared to be the only maintenance work. Due to the extent of cracking the service life of this project should be reduced by 1.5 to 2 years. Service life is estimated at 11± years.

	Project	Traffic Index	Overlay Thickness	Date Placed	Service Life
17.	07-LA-214 0.0/3.5	8.5	0.20'(Rt.Lanes) 0.15'(Lt.Lanes)	4/71	132 months

Comments:

A condition survey made during March 1980 showed the pavement to be in excellent condition. Very little cracking was noted. This portion of the highway was relinquished to the City with the T.I. remaining about the same. No major maintenance has been performed. This project can be extended at least 2 more years (11 yrs.).

	Project	Traffic Index	Overlay Thickness	Date Placed	Service Life
18.	07-LA-14 29.5/31.6	9.5	0.33'	5/67	156 months

Comments:

A PMS survey shows in cracking for 1978 data. The L.A. County Materials Engineer indicated that no maintenance has been performed on this section of roadway since relinquishment. Service life projected to 1980 (13 yrs.).

	Project	Traffic Index	Overlay Thickness	Date Placed	Service Life
25.	Thurber (Santa Cruz)	6.0	0.25'	1970	120 months

Comments:

The condition survey made in February, 1980 showed the project to have reached its service life. Although little patching was noticed, the pavement had reached a 40-50 percent alligator cracked condition in the wheelpaths. As discussed in the text, cracking accelerates rapidly past the 30 percent level, and a reduction of 1 year would probably be excessive. The service life is considered to be reached in 1980 (10 yrs.).

	Project	Traffic Index	Overlay Thickness	Date Placed	Service Life
26.	Mountain View Road (Santa Cruz)	6.0	0.20'	1970	120 months

Comments:

The condition survey made during February, 1980 showed the project had 40-50% alligator cracking in the wheelpaths. Isolated areas had been chip sealed (10%+). The service life of the project has been reached (10 yrs.). (Same rationale as for project 25.)

	Project	Traffic Index	Overlay Thickness	Date Placed	Service Life
27.	Market St. (Riverside)	7.5	0.15'	1971	120 months

Comments:

The condition survey made during March, 1980 showed a chip seal had been placed over both lanes. very little cracking was noted through the seal. It does not appear that a structural problem was the reason for the seal application. Estimate of service life projected 1 year to 1981 (10 yrs.).

	Project	Traffic Index	Overlay Thickness	Date Placed	Service Life
22.	09-Mno-06 0.00/7.00	8.0	0.10' & 0.20'	4/72	96 months

Comments:

This project was rated by PMS surveys and district personnel. No maintenance work has been done since the overlay was placed. Project service life is estimated at 8 years based upon PMS study.

	Project	Traffic Index	Overlay Thickness	Date Placed	Service Life
23.	Empire Grade (Santa Cruz)	6.0	0.20'	1970	144 months

Comments:

The condition survey conducted during February, 1980 showed the overall condition of the roadway to be excellent with no alligator cracking, one percent longitudinal cracking and approximately one percent patching. The service life of this project is projected to 1982 (12 years).

	Project	Traffic Index	Overlay Thickness	Date Placed	Service Life
24.	Capitola Rd. Extension (Santa Cruz)	6.0	0.20'	1970	132 months

Comments:

The condition survey made during February 1980 showed the project to have 10 percent longitudinal cracking and 20 percent alligator cracking. Some patching was noted (±5%) This project should receive some rehabilitation work next year (service life 11 yrs.).

	Project	Traffic Index	Overlay Thickness	Date Placed	Service Life
31.	06-Tul-579(9) (Tulure County)	-	0.25'	1965	180 months

Comments:

A condition survey was made during March, 1979. Longitudinal cracking of 10 percent was noted with 15 percent alligator cracking. Some patching was evident (5± percent). Service life could be extended 1 year (15 yrs.).

	Project	Traffic Index	Overlay Thickness	Date Placed	Service Life
32.	College Park (Davis)	4.0	0.17'	1967	168 months

Comments:

The condition survey made during January, 1979 showed the four projects in Davis (this project and also Nos. 33, 34, 35) to be in excellent condition. No cracking or patching was noted on any of the projects. The service life could conservatively be extended 2 years for these four projects (14 yrs.).

	Project	Traffic Index	Overlay Thickness	Date Placed	Service Life
33.	Second Street (Davis)	4.0	0.17'	1967	168 months

Comments:

(See Project No. 32)

	Project	Traffic Index	Overlay Thickness	Date Placed	Service Life
28.	Central Ave. (EBL only) (Riverside)	8.5	0.15'	1971	120 months

Comments:

Project was reviewed during March, 1980. Some longitudinal cracking was noted (0-5%). Service life was estimated as 10 yrs. minimum.

	Project	Traffic Index	Overlay Thickness	Date Placed	Service Life
29.	SBd-FAS-693 (Riverside)	9.0	0.17'	1967	132 months

Comments:

The condition survey made during March, 1980 showed 5 percent longitudinal and 20 percent alligator cracking. Some areas had been chip sealed (obscured some cracks). Service life estimated at minus one year (1979) to be conservative.

	Project	Traffic Index	Overlay Thickness	Date Placed	Service Life
30.	Estudillo St. (Martinez)	4.5	0.20'	1968	156 months

Comments:

The condition survey made during February, 1980 showed 10 percent longitudinal and approximately 5 percent alligator cracking. Service life could be extended 1 year (13 yrs.).

	Project	Traffic Index	Overlay Thickness	Date Placed	Service Life
37.	Dakota Street (Fresno)	7.0	0.08'	1970	108 months

Comments:

This project is in fair condition. About 15 percent longitudinal cracking with some chip sealed areas were noticed. A condition survey was made during December 1979. With the chip seal probably placed to seal cracks, the service life should be considered near its end (say 1979 - 9 yrs.).

	Project	Traffic Index	Overlay Thickness	Date Placed	Service Life
38.	Fresno Street (Fresno)	8.0	0.08'	1968	132 months

Comments:

The condition survey made during December, 1979 showed the total project to have 10 percent longitudinal cracking with 15 percent alligator cracking. The outer wheelpath was in poor condition. Alligator cracking should accelerate quite rapidly (10% longitudinal). To be conservative, assume service life ends this year (1979).

	Project	Traffic Index	Overlay Thickness	Date Placed	Service Life
39.	California Street (Stockton)	6.0	Dbl. Chip Seal	1966	168 months

Comments:

A condition survey made during April, 1979 showed 5± percent longitudinal cracking. The roadway appears to have good structural strength with some block cracking. All cracks have been sealed. The service life could conservatively be extented 1 year (14 yrs.).

	Project	Traffic Index	Overlay Thickness	Date Placed	Service Life
34.	Sixth Street (Davis)	4.0	0.17'	1967	168 months

Comments:

(See Project No. 32)

	Project	Traffic Index	Overlay Thickness	Date Placed	Service Life
35.	'J' Street (Davis)	4.0	0.17'	1967	168 months

Comments:

(See Project No. 32)

	Project	Traffic Index	Overlay Thickness	Date Placed	Service Life
36.	15th Street (Chowchilla)	6.0	0.17'	1967	144 months

Comments:

The condition survey for this project was made during December, 1979. Intermittent alligator wheelpath cracking (10± percent) with 15 percent longitudinal and transverse cracking were noted. About 5 percent of the project was patched in the wheelpath area. Estimated service life is 12 yrs.

	Project	Traffic Index	Overlay Thickness	Date Placed	Service Life
40.	Center Street (Stockton)	7.0	0.17'	1966	180 months

Comments:

This project, placed in 1966, was review during April 1979. The condition survey showed the pavement to have 5 percent longitudinal, 5 percent alligator and 5 percent patching in the wheelpath areas. The service life could be extended 2 yrs. (15 yrs.).